3.0 ROOT CAUSE ANALYSIS

This section describes the DOE-ORO BJC root cause analyses. These root causes address: areas of concern raised in the DNFSB October 15, 2001 letter to DOE from the DNFSB; and findings and causal factor identification from subsequent DOE and BJC assessments of operations of nuclear facilities summarized in Section 2.0.

3.1 DOE ROOT CAUSE

In addition to root causes and contributing factors associated with the four DNFSB Areas of Concern, the ORO Root Cause Analysis resulted in additional recommendations that are being listed as Findings in this CAP with corrective actions. (See Findings #ORRC1 and #ORRC2)

3.1.1 DOE SB Root Cause Analysis

Problem Statement

Inadequate SB authorization and management system for AMEM nuclear facilities managed by BJC.

Problem Definition and Background

DOE-ORO reviewed the implementation of BJC's ISMS in February 2000. That review identified numerous issues associated with the development of and adherence to AB, and the absence of nuclear safety orders from the WSS and the BJC contract. In October 2000, DOE-ORO conducted a follow-up review that closed 40 of the 50 original findings, but identified 25 more, many of which related to the same areas identified in the February 2000 review. At that time the ISMS process was approved with expectation that both DOE-ORO and BJC would demonstrate continuous improvement.

In October 2001, the DNFSB conducted a review of defense nuclear facilities operated by BJC and found that many of the deficient conditions remained uncorrected. Consequently, the DNFSB requested a DOE-HQ independent assessment of the AB and safety posture for each of the BJC defense nuclear facilities. The assessment was conducted December 2001 – January 2002, and identified numerous deficiencies regarding DOE-ORO and BJC SB authorization and approval processes. According to the DOE-HQ assessment report issued by Dae Chung, assessment team leader, "a systemic breakdown was found in nuclear safety management systems and processes within both ORO and BJC." Specifically, the assessment team noted the following:

1. Technical deficiencies in the development, review, and maintenance of SB documents.
2. No functioning systems in place within BJC or ORO for SB document control, receipt, or tracking.
3. No ORO wide procedure in place for review and approval of SB documents.
4. No ORO Corrective Action Tracking System (CATS) to monitor and ensure closeout of assessment deficiencies.
5. Inadequate technical resources within AMEM and Assistant Manager for Environment, Safety and Health (AMESH) for review, approval, and oversight of nuclear facility SB documents in a timely manner.
6. Lack of management priority, accountability, and structured process to ensure nuclear safety issues are raised to the DOE-ORO Manager.

Contributing Factors

CF/ORSB-1 Exclusion of applicable DOE nuclear safety requirements in the BJC contract.
CF/ORSB-2 No consequences for not having an approved SB document.
CF/ORSB-3 Lack of management priority and accountability.
CF/ORSB-4 Lack of an ORO wide procedure for development, review, and approval of SB documents. Roles and responsibilities for AMEM and AMESH were not clear.
CF/ORSB-5 Insufficient technical capabilities for development, review, and management of SB documents.
CF/ORSB-6 Lack of an independent SB assessment function.
CF/ORSB-7 DOE technical support contractors used trainees and unqualified staff to prepare SB documents.
CF/ORSB-8 SB decisions are expert-based, relying on key individuals, rather than a standards-based system driven by requirements and supported by established systems and procedures.

Root Causes

1. The ORO belief that the nuclear safety risks for the BJC work was not significant.

This belief stemmed from the fact that the BJC work involved demolition and site clean-up, and the facilities were not in an operational mode. High risk and probability assigned to the industrial and chemical safety hazards inherent in the work rather than to the nuclear safety hazards, which were considered low probability. Therefore, nuclear safety requirements were not deemed necessary to operate the facilities safely. The WSS in the BJC contract were deemed necessary and sufficient. Implementation of nuclear safety requirements were considered to be too costly with regard to perceived risk.

2. Lack of accountability and consequences for not having approved SB documents.

There was no clear set of ORO expectations, standards, and performance measures for SB. The line organizations were responsible for SB authorization and approval with guidance and support from the AMESH organization on an "as needed basis" and only as requested. Under this arrangement, line organizations could "answer shop" and use unqualified in-house personnel or contractors to expedite SB reviews. Further complicating this was a breakdown in communications between AMEM and AMESH creating a lack of trust and collaboration between the two organizations. There were no consequences for AMEM not having an independent review using SB experts in AMESH. Furthermore, there were no consequences for the two organizations not working together and seeking to find solutions to problems. There are no formal mechanisms established to resolve conflicts and technical disagreements between AMESH and AMEM. Consequently, the path of least resistance was chosen. All these choices are influenced by the belief that the nuclear safety risks were not significant for the BJC work that resulted in a lack of management priority and accountability for having approved SB documents.

3.1.2 DOE Root Cause Analysis of WSS Issue

Problem Statement

DOE Orders of Interest important to nuclear safety were not included as requirements in the M&I contract WSS.

Problem Definition and Background

The DNFSB and the DOE-HQ Independent Assessment Team reviewed the BJC contract and found that many of the DOE orders important to nuclear safety are not requirements in the contract, but instead are cited as guidance. Appendix E of the BJC M&I contract contains the baseline list of applicable directives that govern all BJC's work activities. Mandated by the list is a set of WSS. Although BJC is responsible for 29 Hazard Category 2 and 3 nuclear facilities, the WSS did not include all applicable nuclear safety directives and standards. Of primary concern to the DNFSB and the DOE-HQ Independent Assessment Team is DOE 5480.23, *Nuclear Safety Analysis Reports*, which was not included as a requirement. Therefore, annual updates for SB documents are not required for BJC. This has contributed to outdated SB documents that do not reflect current facility configurations, hazardous material inventories, and current controls. Some nuclear safety directives were included, but these were only for BJC Category 2 nuclear facilities. The rationale for omitting the nuclear safety requirements is not given in the WSS documents since the process for "necessary and sufficient sets of standards" (DOE Manual 450.3-1) does not require formal justification when requirements and standards are not selected.

Contributing Factors

CF/OROI-1	Belief that nuclear safety risks were not significant for BJC work.
CF/OROI-2	10 CFR 830, Subpart B, SB Requirements did not exist.
CF/OROI-3	No formal consequences for omitting nuclear safety requirements from the WSS.
CF/OROI-4	DOE Manual 450.3-1 *The DOE Closure Process for Necessary and Sufficient Sets of Standards* allows omission without formal justification.

Root Cause

The ORO belief that the nuclear safety risks for the BJC work was not significant.

This belief stemmed from the fact that the BJC work involved demolition and site cleanup. The facilities were not in an operational mode. Industrial and chemical safety hazards were considered to carry a higher risk. Because of the nature of the work, nuclear safety hazards were considered to be low probability. Therefore, nuclear safety requirements were not deemed necessary to operate the facilities safely. Implementation of nuclear safety requirements were considered to be too costly with regard to the perceived risk.

3.1.3 DOE Root Cause Analysis of Technical Competence Issue

Problem Statement

Inadequate technical expertise in ORO to manage the SB for nuclear facilities.

Background and Problem Definition

According to the Chung Assessment report, there was no indication that consideration was given to the adequacy of technical resources needed to accomplish required SB reviews and approvals, when approval authority was delegated. Further, no management accountability expectations or mechanisms were established to ensure that approval authorities were adequately exercised. Delegation letters from EM HQ and within ORO provided no basis for granting approval authority, nor did the recipient organizations attempt to communicate their capabilities. The AMEM office does not have the staffing and technical resources necessary to effectively exercise its nuclear safety management responsibilities. Likewise, the AMESH office does not have adequate staffing to support all the SB reviews and approvals.

Through attrition, promotions, lateral position changes, and budget cuts, staff and positions have been lost and there is limited funding available for support service contractors.

Contributing Factors

CF/ORTC-1 ORO-wide staffing reductions and hiring limitations due to budget cuts.
CF/ORTC-2 Staff changes in Nuclear Safety Division (NSD). Positions were lost along with people. Two people retired, two promoted, and two made lateral position moves.
CF/ORTC-3 When people leave, corporate knowledge and experience is lost. Cannot hire new person until after other person has left.

Root Causes

1. The ORO belief that the nuclear safety risks for the BJC work was not significant.
2. Lack of management accountability and consequences for not having approved SB documents.

3.1.4 DOE Root Cause Analysis of ISMS Issue

Background and Problem Definition

Declaration of ISMS verification may have been premature.

The DOE-ORO reviewed the implementation of BJC's ISM system in February 2000. That review identified numerous issues associated with the development of and adherence to safety AB, absence of nuclear safety orders from the WSS, and the lack of clear definition of and competence to execute roles and responsibilities within both DOE-ORO and BJC. In October 2000, DOE-ORO conducted a follow-up review that closed 40 of the 50 original findings, but identified 25 more, many of which related to the same three areas identified in the February 2000 review. On November 7, 2000, the DOE-ORO manager declared BJC's ISM program implemented, subject to BJC's completing additional corrective actions. In October 2001, the DNFSB conducted a review of defense nuclear facilities operated by BJC. The DNFSB found that many of the deficient conditions found in the earlier ISM program assessments remained uncorrected. For example, as of October 1, 2001, the DNFSB found that neither DOE-ORO nor BJC had compiled a complete list of their safety AB documents, 18 months after the condition was first highlighted by DOE's ISM system review. On November 1, 2001, the DOE-ORO manager revoked ISM System implementation for BJC and the DOE-ORO Office.

Contributing Factors

CF/ORIS-1 No centralized ORO corrective action tracking and reporting system to bring open issues to management's attention and ensure closeout of ISM System verification findings.
CF/ORIS-2 No performance standards were set for successful completion.
CF/ORIS-3 Unclear who was accountable for the ISMS.
CF/ORIS-4 Lack of management priority and accountability for closing the findings.

Root Causes

1. Lack of management priority and accountability for closing the ISM system deficiencies.

There were two options considered when deciding whether or not to declare ISMS implementation. Option 1 was to withhold implementation pending verification of further BJC and DOE-ORO actions. Option 2 was to approve implementation now and focus on the core function of feedback

and continuing improvement to implement the needed change. Option 2 was selected and the ISMS was declared implemented, subject to BJC's completion of additional corrective actions. The rationale for this decision was to send a strong, clear message that DOE expects a contractor's ISM program to be in place and functioning today as well as in the future. DOE-ORO and BJC had invested a significant amount into program implementation and DOE thought it important to reinforce that progress and accountability expected of the program. The thought was to rely on the ISM program core function of feedback and continuing improvement to further drive the needed corrective actions and institutionalize the program in the workplace. Selection of option 2 and reliance on the ISMS improvement process failed to achieve the desired outcomes.

There was a lack of management priority and accountability for closing the ISM program deficiencies. Continued ISM action was thought to be discretionary and not a priority since it had been implemented. There was a lack of consequence and accountability for not following up on the corrective actions, yet there was no central tracking system to elevate the deficiencies to management's attention.

3.2 BJC ROOT CAUSE

The findings, observations, conclusions, and recommendations from these assessments were evaluated by a group of ISMS Improvement Project Team leaders and Performance/Quality Assurance (P/QA) staff. The evaluation team included personnel trained in TapRoot, Barrier, Fault Tree, Kepner-Trego, and other root cause methods designed to obtain and analyze data necessary to understand relevant causal factors and institute sustained improvements. Because this effort primarily focused on why the administrative barriers in place did not prevent these events, Barrier Analysis was used as the preferred tool for root cause analysis consistent with BJC Procedure BJC-PQ-1230, "Root Cause Analysis".

3.2.1 BJC SB Root Cause Analysis

The root cause analysis responded to the DNFSB letter of October 15, 2001 and augmented the previous root cause analysis documented in NTS report (Section 2.2, BJC NTS Report). The causal analysis included review of the independent assessment report issued by DOE-HQ, the summary report on the 28 internal SB document flowdown assessments for Category 2 and 3 nuclear facilities, findings from the joint DOE-ORO/BJC SB Technical Adequacy Review, and four additional occurrence reports describing SB- related concerns.

Issue: Development, maintenance, and implementation of SB documents have not been managed to consistently assure adequate implementation.

Causal Factors:

CF/BJCSB-1 Facility hazard documents were developed by multiple organizations from multiple prime contractors at five sites over many years to varying standards/procedures with varying DOE expectations, reviewers, and review processes.

CF/BJCSB-2 Expectations and requirements with respect to AB and facility hazard document development, maintenance, and implementation have evolved and changed from DOE orders to WSS to 10 CFR 830 Subpart B, while the base documents have remained unchanged. "Old" documents are sometimes reviewed per newer standards and found lacking.

CF/BJCSB-3 Traditional AB document structures (Safety Analysis Reports [SARs], Basis of Interim Operations [BIOs], etc.) and associated safety analysis requirements, e.g., natural phenomena, were developed/designed for operating facilities and have not been "readily applicable" to many EM facilities (shutdown, inactive facilities, burial grounds, contaminated sites, etc.) and activities (facility surveillance and maintenance [S&M], environmental remediation, decontamination and decommissioning [D&D], etc.). Many of these issues will be resolved as documents are updated to 10 CFR 830 Subpart B safe harbor methodology.

CF/BJCSB-4 In some instances, the technical basis supporting AB documents is not clearly documented and does not meet current expectations.

CF/BJCSB-5 Updating AB documents has been viewed by some DOE, BJC, and subcontractor personnel to be of lesser importance for some EM facilities due to their shutdown, inactive status and planned disposition, resulting in a lack of rigor in AB management and implementation.

CF/BJCSB-6 While AB documents, i.e., SARs and BIOs, have been maintained via the Unreviewed Safety Question Determination (USQD) process, periodic updates/revisions have not been processed, resulting in some AB documents having numerous USQDs and being difficult to understand, implement, and utilize.

CF/BJCSB-7 DOE and BJC have been reluctant to expend resources to update AB documents for shutdown, inactive facilities planned for demolition/disposition/remediation.

CF/BJCSB-8 The M&I contract did not require formal updates to AB documents as a part of contract transition. Additionally, the BJC contract transition plan did not include provisions for formal AB document revisions to bring documents up-to-date for new prime contract conditions. Document updates were made via the USQD process.

CF/BJCSB-9 The basis for facility categorization developed by the prior prime contractor, has not been maintained current, and has not been well understood by DOE-ORO and BJC managers. Although the due diligence report submitted by BJC in October 1998 identified that the AB documents had been prepared by the prior contractor and not BJC, DOE-ORO EM and BJC relied on the adequacy of those documents for continued EM activities.

CF/BJCSB-10 AB for EM facilities were administered for many years on a decentralized basis without an integrated, central document control and record management process, resulting in difficulties in identifying and assuring completeness of AB documents. While actions have been taken to strengthen the document control and records management process for AB documents, further improvement is needed.

CF/BJCSB-11 The DOE-ORO and BJC processes for administering AB documents has not been effective in managing interfaces. There was a lack of a consistent interface protocol, i.e., AB document submittals were from multiple points in BJC to multiple points in DOE-ORO EM, resulting in "lost" documents and difficulties in DOE tracking, review, and approval.

CF/BJCSB-12 DOE-ORO lacked a defined organization, process, and procedures for consistently administering and managing the AB process, documents, and reviews. In some cases, communications between BJC and DOE-ORO have not been effective to assure timely resolution of AB-related issues and comments.

CF/BJCSB-13 BJC has not established minimum qualification requirements for personnel in facility management positions for nuclear category 2 and 3 facilities.

CF/BJCSB-14 In some cases DOE-ORO EM, BJC, and subcontractor personnel with facility management responsibility for AB development and implementation have not been sufficiently familiar with AB documents, requirements, and implementation.

CF/BJCSB-15 SMPs and associated SMP descriptions in SB documents (SARs, BIOs, etc.) varied across multiple sites and were not consistently updated to reflect corporate programs under the M&I contract. SMP descriptions in some SB documents reflect programs implemented by the previous contractor.

CF/BJCSB-16 BJC and subcontract managers were not held accountable in rigorously exercising nuclear safety roles, responsibilities, and authorities in facilities some of which had transitioned from their original missions to S&M without approved updates to the SB documents.

CF/BJCSB-17 BJC and subcontractors have not implemented a uniform set of requirements in the respective USQD process documents.

CF/BJCSB-18 The flow-down of SB requirements into BJC and subcontractor procedures was not rigorously administered.

Root Cause: The DOE-ORO and BJC processes and organizational alignment for management of AB documents have not been fully integrated, nor well documented.

3.2.2 BJC DOE Orders of Interest Root Cause Analysis

The October 15, 2001 letter from the DNFSB questioned the rationale for not including relevant DOE nuclear safety directives in the BJC contract. Some DOE nuclear safety orders were listed as guidance or were partially incorporated into the contract. While implementation guidance allows tailoring or grading of directives, the guidance was not consistently applied. BJC initiated a comprehensive review of the 109 Orders of Interest to the DNFSB attached to the October 15, 2001 letter. In addition, an evaluation of the standards change control processes was initiated.

Issue: DOE Orders of Interest important to nuclear safety were not included as requirements in the M&I contract WSS.

Causal Factors:

CF/BJCOI-1 Lack of a process to periodically evaluate the completeness of the WSS to accomplish the BJC scope.

CF/BJCOI-2 BJC assessments did not identify gaps related to DOE nuclear safety directives.

Root Cause: The WSS process failed to identify an adequate set of nuclear safety standards.

3.2.3 BJC TECHNICAL COMPETENCE ROOT CAUSE ANALYSIS

The BJC baseline qualification program assessment utilized information from the SB flowdown evaluations, internal and external independent assessments and reviews of the nuclear facility personnel qualification requirements. Two of the areas of weakness identified by the baseline management assessment relate directly to those cited by the DNFSB. It was determined that there was in some cases less than adequate knowledge and familiarity with SB documents by key facility personnel.

Issue: Sufficient technical expertise is not in place to accomplish responsibilities required by the SB for nuclear facilities.

Causal Factors:

CF/BJCTC-1 The lack of minimum qualification requirements permitted some personnel to be placed in positions of responsibility who did not have the requisite background and experience with the facility safety documents and the associated controls.

CF/BJCTC-2 The lack of established minimum acceptable staffing levels allowed the transition between DOE prime contractors to occur with less than sufficient technical staffing and resources to support nuclear facility management or SB responsibilities.

CF/BJCTC-3 Standards, policies, and procedures for staffing nuclear facilities were incomplete. In particular, the absence of standards in the area of personnel selection, training and qualification created the shortcomings in technical competence.

Issue: A rigorous program has not been maintained to ensure that competencies are commensurate with roles and responsibilities.

Causal Factors:

CF/BJCTC-4 At the time of prime contract transition, BJC did not formally verify and document qualification of nuclear facility staff in terms of education, experience, previous qualifications, and job related training.

CF/BJCTC-5 The reliance on industry standards for the establishment of qualification requirements contributed to failure, in some cases, to establish sufficient requirements based job responsibilities.

CF/BJCTC-6 The process for the establishment of training and qualification requirements based on an analysis of the job requirements lacked formality.

Root Cause: The BJC training and qualification for personnel involved in nuclear facility operations did not meet the expectations of DOE Order 5480.20A, which was not included in the BJC contract.

3.2.4 BJC ISMS Improvements Root Cause Analysis

Based on questions regarding the maturity of BJC ISMS implementation, BJC re-examined the OFIs from the February 2000 DOE verification. The review of corrective actions in response to these OFIs indicated that half of the actions did not effectively address the original issues. Subsequent consultation with outside ISMS experts identified additional areas for improvement. In particular, the lack of an effective trend analysis process to promote feedback and improvement and a formalized approach to utilization of subject matter experts (SMEs) were cited.

Issue: Feedback and improvement process has not been fully effective to ensure an expected degree of ISMS maturity.

Causal Factors:

CF/BJCIS-1 OFI corrective actions were not effective in some areas.

CF/BJCIS-2 Issue closure process for ISMS corrective actions did not adequately assess effectiveness.

CF/BJCIS-3 Analysis/trending of performance data was not effective in identifying improvement opportunities.

Issue: ISMS implementation by BJC failed to adequately assure ongoing effectiveness and continuous improvement.

Causal Factors:

CF/BJCIS-4 Roles, responsibilities, and structure for SMEs were not clearly defined.
CF/BJCIS-5 Indicators of ISMS weaknesses were not synthesized to enable detection of overall program deficiencies in some areas.
CF/BJCIS-6 Lack of rigor in enforcing field implementation of existing requirements.

Root Cause: The maintenance of ISMS was not effective.

3.2.5 Root Cause Summary

Based on the DOE-ORO and BJC root cause analyses, the following root causes were identified:

- The DOE-ORO and BJC processes and organizational alignment for management of AB documents have not been fully integrated, nor well documented.
- The WSS process failed to identify an adequate set of nuclear safety standards.
- The BJC training and qualification for personnel involved in nuclear facility operations did not meet the expectations of DOE Order 5480.20A, which was not included in the BJC contract.
- The ORO belief that the nuclear safety risks for the BJC work were not significant.
- Lack of management accountability and consequences for not having approved SB documents.
- The maintenance of ISMS was not effective.
- Lack of management priority and accountability for closing ISMS system deficiencies.